SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

An Evaluation of the Usability of EN 16883:2017

Suggestions for enhancing the European guidelines for improving energy performance of historic buildings

IEA SHC TASK 59 | EBC Annex 76
Renovating Historic Buildings Towards Zero Energy

An Evaluation of the Usability of EN 16883:2017

Suggestions for enhancing the European guidelines for improving the energy performance of historic buildings

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IEA SHC Task 59 | EBC Annex 76: Deep renovation of historic buildings towards lowest possible energy demand and CO_2 emission (NZEB)

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1 Summary

The balancing of preservation aspects and energy efficiency is a key challenge in the sustainable management of built heritage. There is a need to get a better fundamental understanding of the processes, barriers and constraints involved in the planning of energy retrofits in historic buildings, and what role standards and guidelines can have in decision making.

The European standard EN 16883:2017 *Conservation of cultural heritage. Guidelines for improving the energy performance of historic buildings* is meant to be used by building owners, authorities and professionals involved in the conservation and refurbishment of historic buildings. The standard acknowledges the challenges and opportunities connected with improving the energy performance in historic buildings, and the aim is to facilitate a systematic interdisciplinary planning process that will identify solutions on a case-by-case basis.

The aim of this study was to evaluate the use of EN 16883. The results are useful for deciding how the standard can be applied and advertised, and define what kind of complementary resources and activities that are needed. Furthermore, the results are of interest for both researchers and policymakers to improve the design and development of future guidelines and standards, including a revision of EN 16883.

The evaluation was carried out through case studies and expert elicitation. The planning process regarding energy retrofit in three case studies in Norway and Sweden were studied with interviews and participant observation. The experiences from six research projects applying the standard were elicited with a survey and a workshop.

The results show that there is a general comprehension that the standard is based on sound ideas and supports good practice in the planning of energy retrofit in historic buildings. There is however low motivation among potential users for adopting the standard, as the benefits are uncertain and there is a lack of external pressures. Many users have also been uncertain about how to carry out the steps suggested by the standard in practice.

Based on the results, it is suggested that complementary, and easily accessible, information is needed to support adopters. Such information should provide users with:

- Examples of how the steps in the standard can be carried out
- Example of how the standard can be integrated with existing standards and procedures
- Examples of energy retrofits and energy efficiency measures
- Examples showing the benefit of following the standard
- Resources, literature and tools supplementing the steps in the standard

Lastly, to spread the use of the standard in a long-term perspective it is important that it is used in training and education for professionals in the field, and that authorities and stakeholders demand that the standard is used.

2 Introduction

2.1 Background

Buildings with heritage and architectural values have an important role in the transition to a sustainable energy system (Herrera-Avellanosa et al., 2019). When looking at the building stock as a whole, considering the urgency to mitigate climate change in combination with the relatively slow replacement rate of existing buildings with new ones, it is apparent that the energy performance of existing buildings have to be in focus (Intergovernmental Panel on Climate Change (IPCC), 2014). Retrofitting existing buildings to improve their energy performance will affect their function but also their heritage and architectural values. As a significant share of existing buildings have such values, it is important to consider the balance between energy performance and preservation in policy making (Webb, 2017).

The conventional policy solution of exempting officially designated buildings ("listed buildings") from demands on energy performance has substantial drawbacks. There is no distinct separation between buildings with and without heritage significance, and having heritage values does not imply a lack of energy efficiency potential per se (Herrera-Avellanosa et al., 2019). Exempting historic buildings is therefore problematic in two ways. Firstly, there is often a possibility to identify energy efficiency measures that are acceptable from a preservation point of view even in officially designated buildings. Such measures will remain unidentified if energy efficiency is not considered important in the renovation process. Secondly, there are energy efficiency measures that should be avoided, or be better adapted, in non-designated buildings because of their impact on heritage and architectural values. In this case, it is important that heritage values and architectural quality of mundane buildings are considered in the planning process. In both cases, it is also the case that standard energy saving measures can be problematic to use, nevertheless the energy performance can be improved considerably if the right package of solutions for the specific building is identified.

A novel European standard to support the planning of energy retrofits in historic buildings was introduced in 2017: EN 16883:2017 *Conservation of cultural heritage. Guidelines for improving the energy performance of historic buildings*. The standard acknowledges the challenges and opportunities connected with improving the energy performance in historic buildings, and the aim is to facilitate a systematic interdisciplinary planning process that will identify solutions on a case-by-case basis.

Guidelines, in various forms, have played, and continue to play, an important role for dissemination of research results outside of the academic community. When designing guidelines, standard makers face a fundamental dilemma: they have to present generic answers to problems which tend to vary from case to case (Timmermans and Epstein, 2010). Practitioners often have expectations of simple and general guidance even though the problems tend to be complex. During the last years, guidelines and standards in the conservation field have moved away from universal recommendations to process oriented standards which aim to support the decision process in each individual case (Leijonhufvud and Broström, 2018). EN 16883:2017 is an example of a procedural standard. Such procedural guidelines are promising as they are more flexible and allow for individual variation in the end results. However their application might place higher demands on the end user in terms of resources and competence (Leijonhufvud and Broström, 2018).

This report is the result of work performed within the IEA SHC Task 59 Renovating Historic Buildings Towards Zero Energy. A subtask of the project has been dedicated to the study of procedures for how experts can work together to maintain the heritage values of historic buildings, and at the same time make them more energy efficient. The newly launched European standard EN 16883 was from the outset of the project considered a key standard to be evaluated, both for its novel approach and for the uncertainties about how it would be used in practice. The work has been integrated with research projects carried out by Gustaf Leijonhufvud and Tor Broström (funded by the Swedish Energy Agency), and Alessia Buda's PhD project at Politecnico di Milano.

2.2 EN 16883

The European standard EN 16883:2017 *Conservation of cultural heritage. Guidelines for improving the energy performance of historic buildings* is meant to be used by building owners, authorities and professionals involved in the conservation and refurbishment of historic buildings. The aim is to facilitate the selection of appropriate measures in the planning stage. The guidelines are applicable "to a wide range of buildings where special considerations are needed in order to find a sustainable balance between the use of the building, its energy performance and its conservation". Rather than specifying general solutions beforehand, EN 16883 provides a procedure to facilitate the best decision for each individual building. The standard is divided into the following chapters:

1. Scope
2. Normative references
3. Terms and definitions
4. General consideration
5. Overview of the procedure
6. Initiating the planning process
7. Building survey and assessment
8. Specifying the objectives
9. Deciding if improvement of energy performance is needed
10. Assessment and selection of measures for improving energy performance
11. Implementation, documentation and evaluation of improvement measures

The standard includes general information about energy efficient renovation of historic buildings to be considered, as well as an informative annex with examples of checklists for building information and an example of an assessment table to be used in the selection of measures.

2.3 Aim

The balancing of preservation aspects and energy efficiency is a key challenge in the sustainable management of built heritage. There is a need to get a better fundamental understanding of the processes, barriers and constraints involved in the planning of energy retrofits in historic buildings, and what role standards and guidelines can have in decision making.

Generally, little attention is given to if and how standards and guidelines actually are used in practice (Leijonhufvud and Broström, 2018). It is a remarkably under-researched area given the resources and efforts put into the production of standards. EN 16883 is a recent and innovative standard, with a new scope. With this in consideration, the aim of this study is to evaluate the use of EN 16883. This evaluation aims to be useful for deciding if and how the standard can be applied and advertised, and to define what kind of complementary resources and activities that are needed. Furthermore, the evaluation can be of interest for both researchers and policymakers to improve the design and development of future guidelines and standards, including a revision of EN 16883.

The following research questions have guided the evaluation:

- What have been perceived as strengths and weaknesses with the overall approach of the standard?
- How have users interpreted the standard, and how have existing work processes been modified?
- What complementary material, or resources, are users missing?

3 Methodology

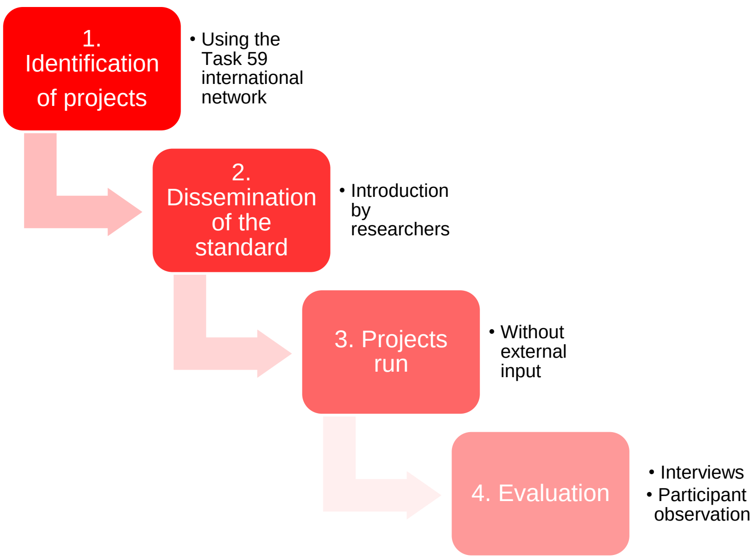
The main ambition of the project has been to evaluate how the standard is used in real projects. We have used the professional networks of the 24 partners of SHC Task 59 in 13 countries to promote the standard and asked if organizations are interested in trying it out, and we have actively searched for projects where the standard is used. This work started in 2017 and has been going on until June 2020.

In addition to the evaluation of projects where practitioners have used the standard, we have also gathered experiences from researchers/experts that have applied the standard in research projects.

3.1 Case studies

Three case studies have been studied during various phases of the planning process. The recruitment of these projects was done in the following way: Firstly, emails were sent through the researcher's professional networks to building owners/managers, architects, energy experts and heritage experts. These emails were both sent to organizations and individuals. The emails briefly introduced the scope of the standard and informed that we were interested in evaluating the use of the standard. After initial contact through email the researchers met with the project partners to introduce the standard and the aim of the research. We tried to be careful not to interpret the standard for the adopters in order not to influence their own interpretation.

Picture 1: The workflow of the evaluation of case studies



After this initial meeting the projects have been free to use the standard to the extent, and in what way, they have found plausible. We have stressed that there is no pressure for them to use the standard, and that a reluctance to use it is just as interesting in terms of the evaluation process

The projects were of different scale and complexity. They have been followed through interviews and participant observation on meetings.

3.2 Expert elicitation from research projects

EN 16883 has attracted considerable interest among researchers active in the field of energy efficiency in historic buildings. We have been in contact with researchers involved in 6 different research projects (RP1-6, see table 1), where the standard has been tested in one or more buildings. Firstly, we have looked at available published results of the studies. We have then conducted an online survey where the involved researchers/experts were invited to contribute with their thoughts about the standard. Based on the results of the survey, a workshop with representatives from the RP:s was held online June 2020 with the aim to condense and consolidate the overall results.

The involved projects have varied in both scope and scale, which is to be expected given the nature of the standard. On one side of the spectrum, a modified version of the standard has been used by a multidisciplinary team in several buildings, and on the other side it has been used meticulously by one person in only one building. A special case is RP 5, where the application of a modified version of the standard has been demanded by the regional authorities to get building permits for renovations in historic buildings.

Table 1: List of cases/projects where the standard has been used. CS= Case Study, RP = Research Project.

ABB.	COUNTRY	DESCRIPTION	CONTACT PERSON/REFERENCE
CSA	Norway	A small project of an energy upgrade of an urban religious building. One energy expert involved together with heritage authorities and owners/users.	Gustaf Leijonhufvud, Uppsala university
CSB	Sweden	Whole building renovation of an 18th century urban industrial building in a poor state. Medium-sized project. Planning team with little pre-experience of renovating historic buildings.	Gustaf Leijonhufvud, Uppsala university
CSC	Norway	Major renovation of a complex monumental building. Interdisciplinary team involved.	Gustaf Leijonhufvud, Uppsala university
RP1	Italy	EN 16883, Mibact guidelines and ASHRAE 34p were tested in three buildings in Sicily and Lombardia. These were rural buildings of medium complexity. Interdisciplinary team involved.	Alessia Buda, Polytecnico di Milano. (Pracchi, V. and Buda, A., 2018)
RP2	Italy	EN 16883 was tested in one listed, ancient building in Genova. Restoration and reuse project with residential and office use oriented towards the realisation of a NZEB pilot case. Interdisciplinary team involved.	Giovanna Franco, University of Genova
RP3	Turkey	EN 16883 was used to select packages of energy efficiency measures in 22 pre- and early-republican residential buildings in İzmir, Turkey.	Zeynep Durmus Arsan, Izmir Institute of Technology (Ulu, 2018)
RP4	Turkey	A preliminary version of EN 16883 was tested on a building in Izmir. A detailed building energy simulation tool was used to determine the impacts of energy efficient retrofits.	Gulden G.Akkurt, Izmir Institute of Technology (Şahin et al., 2015)

RP 5	Belgium	An energy audit scheme based on EN 16883 has been used by the Flanders Heritage Agency. Under some circumstances, it has been mandatory to use it in order to get permit for renovation projects.	Nathalie Vernimme. Flanders heritage agency (https://www.onroerenderfgoed.be/energieaudit-onroerend-erfgoed)
RP 6	France	An early version of the standard was developed and used by a multidisciplinary team to compare packages of energy efficiency measures for seven representative historic buildings in the region of Alsace.	Elodie Héberlé, Cerema (Héberlé et al., 2019)

4 Results

4.1 Case studies

4.1.1 Case study A

In this small project the standard was used by an energy expert to propose energy efficiency measures in an urban church in Norway. The energy expert had some previous experience with energy efficiency in historic buildings. He had heard about the standard through his professional network and wanted to try it out. During different parts of the process, he cooperated with the building owner, the municipality and a heritage expert, but in essence he has been in charge of the project and done most of the work himself.

The objective of the project was to propose energy efficiency measures, not related to a change of use or any other renovation work. The energy expert was hired as a consultant to propose measures that would reduce energy use without compromising heritage values. The energy expert read the standard and tried to use the parts he found interesting on his own. There were no interdisciplinary or stakeholder meetings, as the energy expert thought that the specifications/objectives of the project were quite clear from the outset. In the beginning of the project he had a discussion with the heritage authorities of what types of measures that were allowed in the building. Nothing could be done to the external walls or the windows, so the remaining measures were related to the floor, roof and installations. In the end roof insulation and a change of heat source were selected. A change of use or of the indoor climate was not discussed as the owner had no interest in a change.

The results from this case can be summarized as the following:

- the standard was used to guide the overall structure of the decision-making process
- the part that was used was essentially the systematic procedure to select packages of measures covered in part 10 of the standard, supported by the assessment table in Annex B.
- the standard was described as beneficial because it gives focus to energy performance also in historic buildings
- the proposed decision-making structure was described as good and resonating with common sense and established best practice
- as the standard is not mandatory somebody has to pay for it being used, but clients are almost always very focused on keeping short term costs low. This implies that the standard will not be used if it is not required mandatory by authorities or that major owners of historic buildings decides to use it (according to the energy expert)

4.1.2 Case study B

A medium-sized project involving an urban 18th century industrial building in Sweden. The building, which is owned by the municipality, was in a poor state and the aim for the project has been to renovate it as a cultural center. The building department at the municipality, which had little experience with historic buildings, consulted the standard to come up with a proposal for energy efficiency measures.

In this case, there was a facilitating meeting in the beginning of the project where the researchers introduced the standard and how it could be used. The standard was handed over to the planning group but it seems it was not used to a large extent despite the intentions in the beginning. It is difficult to pin down if any special section of the standard was used or to what extent.

The results of this case can be summarized as the following:

- the planner in charge of the project asked the researchers for advice about how to interpret and use the standard, although there was an initial agreement that the interpretation was up to the user. There was in this case some reluctance to carefully read the standard and to do an independent interpretation, although this was the agreed procedure. An hypothesis is that it was difficult for the relatively inexperienced planner to understand the core idea of the standard.
- The heritage value assessment was performed by an experienced heritage consultant. Neither the instructions given to the consultant, nor the heritage value assessment were carried out in any other way than in conventional projects.
- Neither details in the standard nor the overall decision procedure had a substantial impact on the project. The major purpose of the standard seems to have been to emphasize that this was a special project were heritage values had to play an important role.
- It turned out that setting an energy performance target at an early stage became a critical issue. The iteration between assessment and setting targets was not used.

- In sum, this case study shows that the standard is not self-explanatory to users with little experience from the field of energy efficiency in historic buildings, and complementary training and resources are essential

4.1.3 Case study C

A large and complex project involving the refurbishment of an urban monumental building in Norway. The building is publicly owned and is considered to be of very high heritage value. The standard has been used by an interdisciplinary team to identify and select a package of energy efficiency measures, which has been proposed to be integrated with the planned comprehensive renovation of the whole building.

An initial meeting was held with the researchers where the intention of the study was explained. The standard was handed over to the planning group during the pre-concept phase. The planning group read the standard and were positive to use it in the continuation of the project. When the project moved into the conceptual design phase there was a new group of planners involved in parallel with the original group. In order to introduce the standard to the new group a representative from the National heritage board of Norway was invited to present the standard.

What essentially was used in this project was part 10 of the standard on the selection of measures, as well as the assessment table in annex B. Other parts of the standard were already covered by existing procedures and not changed to any significant extent.

In a large and complex project like this it is difficult to introduce a new way of working due to the fact that there are quite many people involved, and there will only be some of them who have the motivation and interest to try something new. In this case the standard was internally advocated by one planner responsible for environmental management, and intensively read and used by one energy expert. The other planners and consultants were aware of the standard, but showed little interest in using it.

The results of this case can be summarized as the following:

- many aspects mentioned by the standard were in this case covered by existing procedures. The part that was considered innovative was part 10.
- also in this case much of the discussions boiled down to what quantitative target for energy performance that was realistic. The discussion referred to what was considered as (international) best practice
- a heritage expert who had been involved in the standard making process was invited to give a presentation of the standard, both to convince the planning group about its benefits, but also to guide the interpretation. This indicates that the document in itself was not convincing enough for the involved planners.
- the suggested decision-making structure for selecting measures was followed. It was seen to largely follow existing practice, but that the process given in the standard is more structured and explicit, and could open up for unconventional measures to be considered.
- In general, the standard has been described in appreciative terms but it is unclear to what extent the involved organizations will use it in future projects.
- one of the planners thought that there was too little emphasis on building physics in the standard, and that this aspect should be covered in more detail.
- The energy expert argued that the standard forced him to consider unrealistic measures, which he thought was a waste of time. He also said that he in retrospect understood that this was not the intention of the standard.

4.1.4 Research projects

The description below is based on the survey results. The following questions were used in the survey to describe the projects and how the standard was used:

1 **Description**. Describe the project (s) where you have experience with applying EN 16883. Type of building, scale & complexity of the planning, professions involved etc.

2 **Application**. Describe how the standard was applied in the project(s). Which parts of the standard were used? Were they used in detail or as "inspiration"? Who were involved in using the standard?

3 **Impact** on planning process. In the project (s) where you have used EN 16883, how was the planning process changed in comparison to your previous experience?

The answers are edited to improve readability.

RP 1 Italy

The standard was tested in three buildings in Sicily and Lombardia. These were rural buildings of medium complexity. An interdisciplinary team was involved.

Description	Rural Complex Buildings, Medium complexity, Architect/Energy Experts/Structural Eng./Heritage expert/Heritage Board/Private funding Society/Local Community
Application	The Architect followed the standard as an inspiration to plan the interventions.
Impact	The actors involved defined the interventions evaluating several impacts, not only the energy point. They were better guided in the process.

RP 2 Italy

The standard was tested in one listed, ancient building in Genova. Restoration and reuse project with residential and office use oriented towards the realisation of a NZEB pilot case. Interdisciplinary team involved.

Description	Restoration and reuse project with residential and office use oriented towards the realisation of a NZEB pilot case. The Building: historic and very ancient building composed of two floors with vaulted ceilings and very big, arched windowed surfaces. The basement is above ground for the most but once it was underground, probably a cistern for rainwater collection. A medieval column stays In the middle of the room. The last floor is less monumental but it is enriched by a series of windows in Middle Ages style. The rooftop is a terrace and from there a small tower ('torretta') raises for 16 meters. a balcony on the tower offers a wonderful view of thw town of Genoa from the mountains to the port and the farest sea.The professionals involved in the project were: historian-archivist, architect expert in restoration, experts in material diagnostics, experts in seismic diagnosis and improvement, experts in energy efficiency, experts in quality certification processes, geologists, archaeologists
Application	The project started before the standard was published. Nevertheless, the joint objective of conservation and energy efficiency (towards NZEB) has steered the whole project in a direction consistent with the standard.
Impact	N/A

RP 3 Turkey

EN 16883 was used to select packages of energy efficiency measures in 22 pre- and early-republican residential buildings in İzmir, Turkey. These were residential buildings at neighbourhood scale in the scope of a Master thesis.

Description	Residential buildings at neighborhood scale in the scope of Master thesis
Application	Full parts of 10: subparts are used in detail. Thesis advisor and Master student involved in using the standard.
Impact	Assessment criteria and scale is the critical point in decision process. In our study, energy and heritage significance of the building settings have been selected among assessment categories within the part of 10.2. The standard become a guidance for our study. Exclusion of inappropriate measures becomes easier by the standard.

RP 4 Turkey

A preliminary version of EN 16883 was tested on a building in Izmir. A detailed building energy simulation tool was used to determine the impacts of energy efficient retrofits.

Description	It was a MSc. Thesis work on a public building. We tried to give retrofit advices on energy performance vs. heritage value of the building.

Application	N/A
Impact	Risk–benefit analysis was conducted to assess the proposed retrofit packages.

RP 5 Belgium

An energy audit scheme based on EN 16883 has been used by the Flanders Heritage Agency. Under some circumstances, it has been mandatory to use it in order to get permit for renovation projects.

Description	Energy-audit for built heritage= instrument in the Flemish region to retrofit built heritage. A prime can be obtained to develop the audit, an audit is compulsory. The energy-audit is based on the standard. https://www.onroerenderfgoed.be/energieaudit-onroerend-erfgoed and based on the document and method of the integrated description of the conservation process developed in the DEMI MORE Interreg-project. The structure and content follow the standard EN16883: 1. Design or competition brief: targets and ambitions 2. Building survey and assessment 3. Assessment and selection of measures 4. Design implementation 5. Completion and post-occupancy evaluation 6. Operation and maintenance 7. Documentation
Application	N/A
Impact	N/A

RP 6 France

An early version of the standard was developed and used by a multidisciplinary team to compare packages of energy efficiency measures for seven representative historic buildings in the region of Alsace.

Description	The standard was applied in a study called "Habitat ancien en Alsace". The aim was to propose retrofit solutions for 7 heritage buildings in the Alsace region and to communicate the results to the general public, as guidelines. We (building physics engineers) and a heritage architect carried out the study, that was funded by both the French Ministry of Culture and the Ministry of sustainable development.
Application	The procedure was used as an inspiration. However, the diagram 1 was strictly followed. [the flowchart of the planning process]
Impact	Difficult to answer, as it was only a simulation study and not real projects.

4.1.5 Expert elicitation

Selected survey results, rephrased for clarity where needed:

Overall impression of EN 16883: What would you say are the strengths and benefits of the standard?

- Concise, attention to the variability of historic constructions. (RP1)
- Organic guidance to the evaluation process and project design and execution. (RP2)
- The multidisciplinary approach, the importance given to the heritage significance. (RP5)
- Each step and the overall procedure are clear and make sense.Very logical and well detailed process. (RP6)

Overall impression of EN 16883: What do you find problematic with the standard?

- The lack of examples (RP1, RP6)
- The procedure is long and time-consuming for contractors. Some steps could be automated (10.3, 10.5, 10.7). (RP6)
- The standard is fee-paying. (French) projects contractors will pay for it only if their clients asked them for. But those clients are often not aware of the existence of this standard. (RP6)

The standard could be accompanied by an example, even an invented one. There could also be training courses about the standard and template documents to fill in (diagnosis, grids like in the appendix). (RP6)

- Focuses on buildings rather than districts/ not a practical tool (RP5)
- The application of the standard is easy for an individual building, but it is hard to implement at the neighborhood scale (RP 3)
- Requires the presence of a technical expert in energy calculations; this, at least until recently, was not required in projects for the recovery and restoration of historic buildings (RP2)

Overall impression of EN 16883: The standard is not used much. What do you think is the explanation?

- The standard requires a broad overview of the topic that professionals often do not have. (RP1)
- Too theoretical (RP5)
- Lack of relevant examples that prove the standard is a good method to assess energy saving interventions (RP5)
- Resistance to the "new" (RP3)
- Lack of interest of restorers to energy issues (RP3)
- You must pay to get the standard (RP1, RP6)
- The standard is not known by the buildings' owners (private or public owners). (RP6)
- Until this standard is made compulsory, at least in Italy, it will be very difficult to find its application in current practice, except in special cases, with the involvement of an interested client or possible public funding (RP2)

Comments on specific parts of the standard:

- The introduction part of the standard (part 4) is too short (RP5)
- The connection between 4.4 and the assessment is not made clear (RP5)
- Part 7 misses the explanation of the EN 16247-2: three types of building survey (walk-through, standard and tailor) despite the norm is quoted, in the Annex A (the checklist linked to this section), there is a general checklist, which does not include in detail aspects related to the energy performance of the building. (RP1)
- The building survey should be separated from the assessment. (RP5)
- The rationale for part 8, setting the objectives, is not clear. Example or explanation needed. Should be moved to the beginning “define initial shared goals”. (RP1)
- "Energy measures should be coordinated with an on-going maintenance and repair schedule" this is a good intention but not realized with this standard. (RP5)
- The selection of measures should be better described as something directly linked to the building survey. The risk assessment os solutions does not support to combine scenarios (with which criteria can you do this? how can you combine into packages?) (RP1)
- 10.2 "the assessment can be applied to parts of the building" Not a good idea - holistic approach? (RP5)
- Measures should be explained more detailed within a guidebook, therefore a guidebook is needed. (RP 3)

Final feedback: What changes would you suggest for an updated version of the standard

- Adding examples (RP1) (RP2) (RP6)
- Push the need for initiating setting shared goals (RP1)
- Express how in different situations (different dimension of cases/ different heritage importance) the procedure (in particulare the assessment) can be adapted differently, as in the EN 16247-2 it is done with the different levels of survey. Not all detailed info are needed in the case of a small historic house, rather than in a monumental building. (RP1)
- Automatized version of the assesment table (annex B). (RP2)
- No update needed, build something around the standard (an official website, with, for example, a list of solutions to reuse in step 10.3? Collaborative tools to debate on step 10.5 and 10.7?). (RP6)
- Training courses, template documents. (RP6)
- A guidebook is needed. (RP4)
- The standard has to be promoted and publicized amongst contractors' clients. (RP6).

During the workshop with representatives from the research projects there was a discussion based on the results of both the case studies and the research projects. The outcome of the workshop was a summary of the most important strengths and weaknesses of the standard.

Overall strengths:

- Offers a systematic approach that can open up for other interventions than what team members immediately think of

- The systematic approach advocated for the selection of measures resonates with common sense but is nonetheless seldom used.
- The voluntary and informative elements (many positive users have been “inspired” by the standard rather than strictly followed it)
- The general interdisciplinary approach
- The focus on the potential for energy efficiency also in protected buildings
- Gives attention to heritage aspects early on in the planning process also in the case of non-protected buildings

Overall weaknesses of the standard:
- Confusion about what is mandatory or not
- Uncertainty about how different parts are supposed to be carried out
- Presupposes a large project (e.g. a multi-disciplinary planning team)
- In larger projects, the required parts will to some extent be covered by existing procedures and there is a risk of redundancy
- In smaller projects, the list of what is required can be overwhelming and of questionable benefit.
- Lack of examples
- The focus on the individual building implies missed opportunities of communal solutions and infrastructure
- the iterative character of the planning procedure has not been clearly understood by users

5 Discussion and suggestions

There is an initial, and we think also important, observation based on this study as a whole: the fact that EN 16883 is rarely used in practice. There has been considerable interest in EN 16883 from researchers in the field of energy efficiency in historic buildings. As an example, the standard was mentioned in 13 of the papers presented at the latest conference on Energy Efficiency in Historic Buildings in Visby 2018 (Broström et al., 2018). Despite this interest from the academic community, it has proven difficult to find case studies where the standard has been used by practitioners. Within the IEA SHC Task 59 network we have actively looked for case studies during a period of three years but have only been able to find those listed in table 1. For some reason potential users have not been interested in adopting, or even trying, the standard. It is imperative to understand why this is the case, as there is little use in developing standards if they aren’t used.

There are a number of reasons to why the standard hasn’t been used that are not connected to the design of the standard. Firstly, the standard is new and not well known in the sector. Secondly, the scope of the standard is new, and it is therefore not a matter of replacing an existing standard with a new one. Thirdly, compliance with the standard is not yet demanded by clients or forced by public authorities (except the Belgian case, see RP5 in table 1).

In the literature on the diffusion of standards there is often a distinction made between external and internal motivations for adopting a standard (Heras-Saizarbitoria et al., 2011). External motivations are for example regulatory frameworks or pressure from stakeholders. No such external pressures exist in this case, which means that there must be internal motivators behind the adoption of EN 16883. Internal motivation comes mainly from the expected benefits in the outcome of the project if the standard is used. Expected benefits are weighed by a prospective adopter against the imagined potential costs.

The benefits of using the standard seem to be clear for experts within the field, but less so for the typical practitioner, whom is uncertain about the impact of using the standard. There is a cost in terms of resources (time, cost) to implement the standard, especially in the beginning of the adoption process. A basic idea of the standard is that resources put into the early design phase of a project will reduce long-term costs. However, in practice there is an opposite financial logic. Clients often want to keep initial costs low, and it can be difficult for a consultant to put more than the minimally required effort into planning.

From the perspective of a presumptive first-time user of the standard, there are clearly uncertainties both about the pros and cons of adopting it. According to organizational theory, the decision to adopt a standard will be based on the assumption that the benefits outweigh the drawbacks. When there is uncertainty about the outcome of implementing a new practice, organizations tend to rely more on normative aspects when making a decision, e.g. mimic others, comply to external demand (Delmas, 2002). In the case of a new process standard, with uncertain impacts on outcomes, this might imply that external pressures become more important as a driver of the spread of the standard, for example that it is demanded as mandatory by stakeholders and authorities (Delmas, 2002).

On an overall level, the most emphasized strengths with the standard have been the generic decision-making framework, the interdisciplinary approach and the balanced focus on both heritage and energy aspects. The salient weakness has been the uncertainty among users of how to interpret the standard, i.e. translating the abstract and generic steps of the standard into action.

A recurring problem is that users have had difficulties in interpreting what is required and not in the standard. This seems to have at least two explanations. Firstly, it has to do with how renovation processes are structured. It is only rarely that renovation is made with improved energy performance as the main objective. Rather, energy efficiency is one of many objectives that have to be considered. The logic of the planning process is therefore based mainly on other aspects, and the suggested workflow of the standard has to be integrated with existing planning practices and conventions. This implies that the user of the standard has to select elements of the standard and translate them into working practices that fit with the existing ones. Secondly, it is not always clear in the text of the standard what is required in order to follow the standard. The language is sometimes ambiguous, and aspects that obviously are unnecessary or impossible to fulfil can be perceived as mandatory. For example in smaller projects such as in case study A, it is unrealistic that the qualification requirements of the project team will be fulfilled, or that all aspects of the building survey and assessment are carried out.

An overarching observation is that the standard, as a standalone document, is neither sufficient to convince decision-makers about the benefits of its use, nor self-explanatory for the majority of new users. Here, we can see a clear difference between the research projects and the case studies. The research projects have been led by researchers that from the outset were familiar with the basic ideas of the standard, as well as the potential benefits from applying these ideas. They have also focused more on the details of the standard. In the case studies a major obstacle in the beginning of the process has been for the decision-makers to interpret what the standard is about (its core ideas) and what the potential benefits would be. Despite this reluctance to use the standard, it is evident from the case studies that users of the standard generally have perceived it as relevant and based on sound ideas.

5.1 Suggestions

The results described above strengthens many of the assumptions of the IEA project. Complementary, and easily accessible, information is needed to support adopters. Such information should provide users with:

- Examples of how the steps in the standard can be carried out
- Example of how the standard can be integrated with existing standards and procedures
- Examples of energy retrofits and energy efficiency measures
- Examples showing the benefit of following the standard
- Resources, literature and tools supplementing the steps in the standard

Regarding the standard itself, we suggest that the following recommendations are considered for its next revision.

• Focus on the generic procedure for decision-making. This procedure, which is the core of the standard, should not be concealed by other information. Differentiate clearly between the core of the standard and proposed methodologies/general information.

• Emphasize the iterative nature of the planning process. It is important that users understand that the setting of objectives and the assessment of packages is a matter of negotiation which might require several iterations.

• Make it clear what is required in order to follow the standard (if anything). The jurisdiction of the standard is unclear to users. An alternative would be to emphasize the voluntary aspects, and only require users to follow the generic decision-making procedure (without specifying what is mandatory in each step).

• Adapt the standard so it easily can be used for a stock of buildings, or categories of buildings.

Lastly, to spread the use of the standard in a long-term perspective it is important that it is used in training and education for professionals in the field, and that authorities and stakeholders demand that the standard is used.

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